Medical Science

To Cite:
Sobchynskyi M, Myrny A, Kowalczuk D, Kasianik W, Lazitskaya D, Turlej K, Milasheuskaya V, Kiełbaszewska I, Surosz N, Miraniuk K, Wiczkowski D. Comparative Outcomes of Open, Laparoscopic, and Robotic-Assisted Radical Prostatectomy: A Structured Review. *Medical Science* 2025; 29: e184ms3711
doi: https://doi.org/10.54905/disssi.v29i163.e184ms3711

Authors' Affiliation:
[1]Międzyleski Specialist Hospital in Warsaw, Bursztynowa 2, 04-749 Warsaw, Poland
[2]University Clinical Center of the Medical University of Warsaw, Banacha 1A, 02-097 Warsaw, Poland
[3]Mazovian Rehabilitation Center STOCER Ltd. Saint Anna Hospital, Barska 16/20, 02-315 Warsaw, Poland
[4]Wroclaw Medical University, wyb. Ludwika Pasteura 1, 50-367 Wroclaw, Poland
[5]Independent Public Healthcare Centre in Hajnówka, Doc. Adama Dowgirda 9, 17-200 Hajnówka, Poland
[6]Medical University of Warsaw, Zwirki i Wigury 61, 02-091 Warsaw, Poland
[7]Independent Public Specialist Western Hospital named after St. John Paul II, Daleka 11, 05-825 Grodzisk Mazowiecki, Poland

*Corresponding author:
Mykola Sobchynskyi
Międzyleski Specialist Hospital in Warsaw, Bursztynowa 2, 04-749 Warsaw, Poland
Email: sobczynski0@gmail.com

Contact List:

Mykola Sobchynskyi	sobczynski0@gmail.com
Andrzej Myrny	andmyrnyi@gmail.com
Dmytro Kowalczuk	dmytro.kovalchuk1999@gmail.com
Wiktoria Kasianik	wiktoriakasianik2@gmail.com
Darya Lazitskaya	datskayalo@gmail.com
Kamil Turlej	kturlej99@gmail.com
Valeryia Milasheuskaya	valeryiamilasheuskaya@gmail.com
Iga Kiełbaszewska	kielbaszewska.i@gmail.com
Natalia Surosz	natalia.surosz@gmail.com
Katsiaryna Miraniuk	mironk2711@gmail.com
Dawid Wiczkowski	dawid.wiczkowski@gmail.com

ORCID List:

Mykola Sobchynskyi	0009-0008-1804-1114
Andrzej Myrny	0009-0006-5592-259X
Dmytro Kowalczuk	0009-0004-1433-5052
Wiktoria Kasianik	0009-0004-1540-5227
Darya Lazitskaya	0009-0007-8680-8826
Kamil Turlej	0009-0008-2919-284X
Valeryia Milasheuskaya	0009-0006-4126-2375
Iga Kiełbaszewska	0009-0004-9892-4769
Natalia Surosz	0009-0005-1939-151X
Katsiaryna Miraniuk	0009-0006-1406-9756
Dawid Wiczkowski	0009-0004-7050-9598

Peer-Review History
Received: 14 March 2025
Reviewed & Revised: 23/March/2025 to 01/September/2025
Accepted: 16 September 2025
Published: 27 September 2025

Peer-review Method
External peer-review was done through double-blind method.

Medical Science
pISSN 2321–7359; eISSN 2321–7367

DISCOVERY SCIENTIFIC SOCIETY

Comparative Outcomes of Open, Laparoscopic, and Robotic-Assisted Radical Prostatectomy: A Structured Review

Mykola Sobchynskyi[1]*, Andrzej Myrny[2], Dmytro Kowalczuk[1], Wiktoria Kasianik[3], Darya Lazitskaya[1], Kamil Turlej[2], Valeryia Milasheuskaya[4], Iga Kiełbaszewska[5], Natalia Surosz[1], Katsiaryna Miraniuk[6], Dawid Wiczkowski[7]

ABSTRACT

Radical prostatectomy is the most common therapy method used in the treatment of localized prostate cancer. There are three main approaches to this surgery: open radical prostatectomy (ORP), laparoscopic radical prostatectomy (LRP), and robot-assisted radical prostatectomy (RARP). The review will compare these techniques by assessing their different effects, such as oncologic control, perioperative outcomes, and functional recovery. Oncologic results of all these techniques are generally similar. The RARP is typically characterized by better functional recovery among all three methods. Despite having many benefits, the RARP requires higher costs and has limited access in some healthcare units. Although LRP is minimally invasive, it is less widely adopted due to the longer time it takes to fully master this technique. ORP is still an important approach in some settings, but has a higher morbidity rate and longer recovery time. In choosing between all the methods of treatment for a patient with prostate cancer, the patient's health status, the surgeon's expertise, and the ability of the institution should be considered. Research has to be continued, and the benefits and risks of all types of radical prostatectomy should be compared to guarantee that the best methods will be chosen for treating such a common neoplasm as prostate cancer. Aim of Study: to compare clinical outcomes of open, laparoscopic, and robotic-assisted radical prostatectomy techniques. Main target areas include perioperative parameters, oncologic control, functional recovery, complication rates, and healthcare resource use, to determine the most effective and patient-centered surgical approach.

Keywords: open radical prostatectomy, laparoscopic radical prostatectomy, robot-assisted radical prostatectomy, oncologic outcomes, functional outcomes.

1. INTRODUCTION

Worldwide, the most common malignancy affecting men is prostate cancer. This neoplasm causes significant clinical, social, and economic challenges. There is an increasing number of prostate cancers due to widespread PSA testing and rising life expectancy. The standard treatment for non-metastatic and localized cases of this type of neoplasm is the radical prostatectomy (RP), which is the surgical removal of the prostate and seminal vesicles. There is great importance in decreasing complications and retaining urinary continence and sexual function after this surgery (Kim et al., 2025). There are different surgical approaches to RP, varying from open retropubic RP (ORP) to laparoscopic (LRP) and robot-assisted radical prostatectomy (RARP). Each of these methods has some benefits and disadvantages. Recently, RARP became the most popular method in the USA and countries with similar healthcare systems (Ficarra et al., 2012; Inkaya et al., 2019).

Different studies that compare these techniques show that RARP surgery causes such benefits as limited blood loss, small transfusion needs, shorter hospital stays, and better early recovery of continence and erectile function (Coughlin et al., 2018). Wu et al., (2021) reported fewer 30-day complications with RARP compared to ORP. However, oncologic outcomes such as positive surgical margins (PSMs) and biochemical recurrence (BCR) are generally the same across techniques performed by skilled surgeons. RARP surgery is limited by its high costs and difficulty level. However, the learning time for this procedure may be less than for LRP due to enhanced visualization and control over the instruments (Sooriakumaran et al., 2012; Lowrance et al., 2010). The LRP procedure is less expensive, less technically demanding, and has no tactile feedback, which could affect accuracy in complicated procedures. Trinh et al. found that a surgeon's lack of experience while performing LRP can cause more complications and longer operations (Trinh et al., 2012).

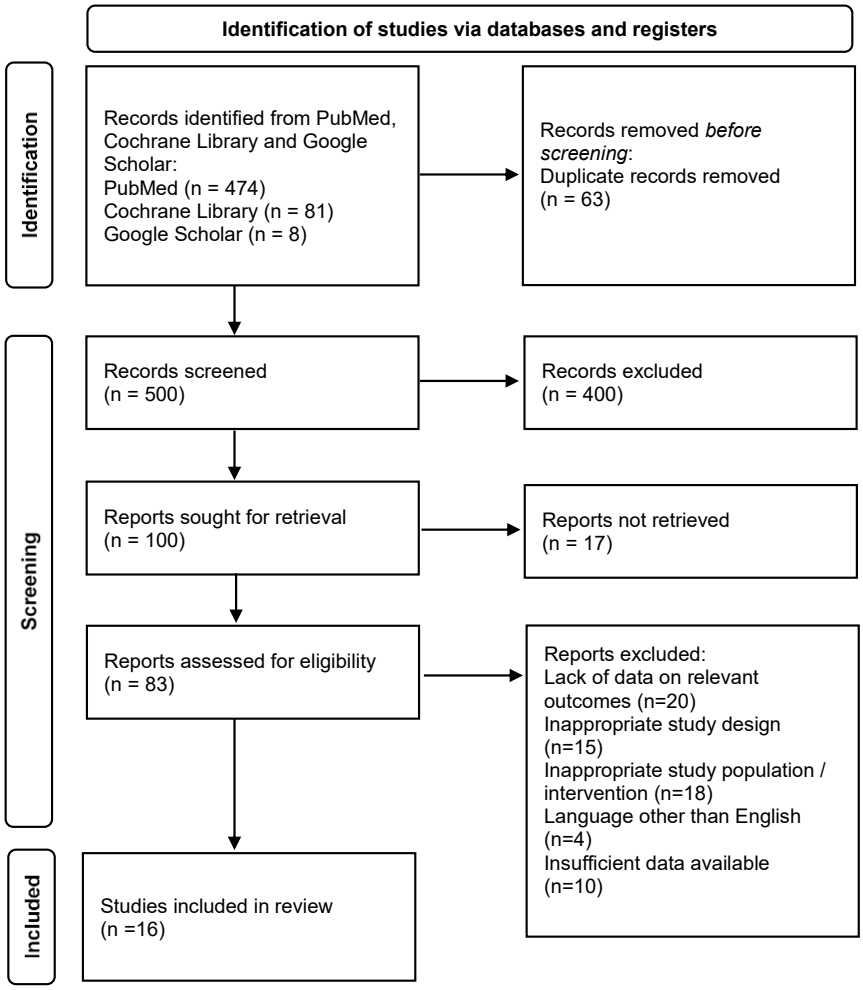

Figure 1: PRISMA flowchart

Functional outcomes such as urinary continence and erectile function are better in early recovery with RARP generally due to improved visualization and precise nerve-sparing (Inkaya et al., 2019; Coughlin et al., 2018). However, surgeon professionalism and institutional level are critical across all these methods. The RARP technique is the most expensive method among all these surgical approaches, but it may cause lower overall expenses due to a reduced risk of complications and a shorter hospital stay (Wu et al., 2021). In conclusion, all these techniques provide an appropriate level of cancer control, but the usage of RARP is associated with some better options, such as early recovery and safety. Still, various factors affect different approaches to cases, such as surgeon professionalism, access to robotic systems, and available resources.

2. REVIEW METHODS

To create this study, the PubMed, Cochrane Library, and Google Scholar databases were searched using keywords related to prostate cancer and its treatment methods. Studies published up to January 2025 were selected and analysed. The results of these studies, which describe the clinical outcomes of different methods of prostate cancer treatment, were analyzed and grouped into several parts, such as perioperative parameters, oncological, and functional outcomes. A total of 16 works were used (Figure 1).

3. RESULTS & DISCUSSION

3.1. Perioperative Parameters

3.1.1. Operative Time

Operative time is a main perioperative parameter that indicates technical difficulty and surgical experience. ORP usually has the shortest operative duration, especially in large healthcare centers with experienced surgeons. LRP presents the longest operative time due to limited visualization, two-dimensional imaging, and demanding suturing. The duration of RARP surgery is usually between ORP and LRP durations, and this duration shortens significantly with higher experience of the operator. In a meta-analysis, Kim et al., (2025) describe that LRP has the longest mean operative time, followed by RARP, and then ORP ($p < 0.01$). Average operative time for RARP surgeries ranges from 160 to 240 minutes, while for LRP it often exceeds 240 minutes, especially if provided by less experienced operators (Ficarra et al., 2012). According to Inkaya et al.'s report, RARP is significantly shorter than LRP (177 vs. 190 minutes; $p < 0.05$) (Inkaya et al., 2019). Although initial RARP learning curves extended beyond 100 cases, the latest data suggest that dual-console mentoring can reduce the learning curve to 25-50 cases (Coughlin et al., 2018).

3.1.2. Estimated Blood Loss

Estimated blood loss (EBL) is one of the most important markers of the operation's safety. The RARP technique has lower EBL than both ORP and LRP methods. According to Wu et al., (2021) EBL for RP is 200 ml for RARP, 400 ml for LRP, and 800 ml for ORP ($p < 0.001$). These results were reaffirmed by Ficarra et al., (2012) in a meta-analysis. Sooriakumaran et al., (2012) also observed a 70% lower chance of bleeding complications with RARP in comparison to ORP. Lower blood loss ensures reduced transfusion needs. ORP is an older surgical method with reported transfusion rates of 15–20%, while the modern RARP technique shows rates of 2–5% (Lowrance et al., 2010; Trinh et al., 2012). LRP transfusion rates range between previous rates but highly vary depending on surgical technique and dissection scale.

3.1.3. Catheterization Duration

Catheter duration depends on tissue healing and anastomosis integrity. Early removal of the catheter is facilitated by the increased security of sutures that the RARP method offers. Average catheter time was 9 days in LRP and 6 days in RARP ($p < 0.01$) according to Inkaya et al., (2019). ORP surgery typically takes 10 to 14 days because of the risk of increased leakage and less controlled anastomosis (Patel et al., 2011).

3.1.4. Hospital Stay

Length of stay (LOS) is the most important determinant of postoperative recovery. RARP surgery has a shorter hospital stay by virtue of less trauma and fewer complications. Median LOS of 1.4 days for RARP, 2.4 days for LRP, and 3.1 days for ORP ($p < 0.001$) according to Wu et al., (2021). Early hospital discharge results in less risk of infection and improved patient satisfaction.

3.1.5. Pain and Drainage Parameters

Drain use is not as frequent in RARP procedures due to the minimal damage to periprostatic tissue. During this procedure, when placed, the drains usually come out within 24 hours. Compared to ORP surgery, it often requires routine drainage for 48 to 72 hours (Tewari et al., 2003). Postoperative pain is generally lower in minimally invasive techniques. Patients who have undergone RARP operations usually require less opioid use and a faster mobilization period compared with the ORP technique (Freedland et al., 2005). The LRP method is also minimally invasive. However, this technique may cause more abdominal wall damage due to the usage of stiff instruments and a longer surgery time (Dalela et al., 2017).

The perioperative outcomes are summarized in Table 1. The choice of the RARP technique offers improved results in terms of blood loss, transfusion rate, catheterization duration, hospital stay, and pain control. Operative times for all methods are reduced with the gain of experience by surgeons. LRP surgery may be better than the ORP technique in some parameters, but it remains more technically complex and less consistent. These perioperative results describe the RARP method as the safest and most recovery-friendly, if the resources and practice allow.

Table 1. Perioperative Outcomes of ORP, LRP, and RARP

Parameter	ORP	LRP	RARP	References
Operative time	Shortest (often <180 min)	Longest (>240 min)	Intermediate (160–240 min)	(Kim et al., 2025; Ficarra et al., 2012; Inkaya et al., 2019; Coughlin et al., 2018)
Estimated blood loss (EBL)	Highest (~800 ml)	~400 ml	Lowest (~200 ml)	(Ficarra et al., 2012; Wu et al., 2021; Sooriakumaran et al., 2012)
Transfusion rate	15–20%	Variable, intermediate	2–5%	(Lowrance et al., 2010; Trinh et al., 2012)
Catheterization duration	10–14 days	~9 days	~6 days	(Inkaya et al., 2019; Patel et al., 2011)
Hospital stay	~3.1 days	~2.4 days	~1.4 days	(Wu et al., 2021)
Drainage & pain	Routine drains (48–72 h); higher pain	Drains often required; abdominal wall discomfort	Minimal drain use (<24 h); lowest pain	(Tewari et al., 2003; Freedland et al., 2005; Dalela et al., 2017)

3.2. Oncological Outcomes

3.2.1. Positive Surgical Margins

The most important challenge while performing RP surgery is to eliminate the neoplasm completely. The indicator of remaining cancer is the positive surgical margins (PSMs) parameter. The RARP technique usually shows lower PSMs compared to ORP and LRP, especially in T2 disease. Kim et al., (2025) reported PSM rates of 14.6% for RARP, 22.1% for ORP, and 19.5% for LRP, and concluded that RARP is noticeably better ($p < 0.01$). These are findings that relate to better visualization and precision in conducting RARP surgery, specifically while operating in the apical and posterolateral zones. In contrast, the ORP method may have higher PSMs due to worse visibility and limited dissection dexterity. However, experienced ORP surgeons can achieve better outcomes (Patel et al., 2011). In ≥pT3 disease, differences in PSM rates are less distinct (Sooriakumaran et al., 2012).

3.2.2. Biochemical Recurrence

Biochemical recurrence (BCR) is described as the PSA marker elevation after prostatectomy. This parameter defines the long-term effectiveness of the operation. There are very similar results of BCR among all RP methods. There was no significant 3-year BCR difference between RARP (91.2%) and LRP (89.1%) in the study provided by Inkaya et al., (2019). Kim et al., (2025) proved the similar BCR rates in RARP (8.5%), LRP (9.3%), and ORP (9.9%) ($p > 0.05$). Differences in BCR are determined mostly by the grade and stage of the tumor, rather than by the surgery type (Freedland et al., 2005).

3.2.3. Lymph Node Dissection

Pelvic lymph node dissection is necessary in the evaluation of the course of the neoplasm and remains necessary for staging. ORP surgery has some advantages due to the possibility of tactile feedback and exposure during the operation. However, some robotic systems now allow comparable results. In a study by Ficarra et al., there were no differences in nodal positivity across modalities with systematic PLND (Ficarra et al., 2012). The lymphadenectomy procedure in RARP surgery is the safest and has fewer complications as a result of enhanced hemostasis (Yaxley et al., 2016). During the LRP technique, it is also possible to achieve adequate yields, but it is less frequently used for extended PLND due to technical challenges and higher risks of bleeding (Dalela et al., 2017).

Specimen Handling

RARP and LRP techniques also allow for the use of retrieval bags. The bags ensure controlled handling of specimens, less capsular disruption, and better pathological examination. This is not comparable but such a possible application can be helpful to a more accurate margin and staging evaluation.

Oncological outcomes are reported in Table 2. All of these three techniques can guarantee satisfactory cancer control if performed by seasoned surgeons. There are some advantages in the usage of the RARP approach, especially when surgery is performed in localized tumors. BCR and lymph node dissection parameters vary greatly across approaches. As a result, the role of tumor characteristics and surgical expertise in oncologic outcomes becomes the main determinant.

Table 2. Oncological Outcomes of ORP, LRP, and RARP

Parameter	ORP	LRP	RARP	References
Positive surgical margins (PSMs)	~22.1%	~19.5%	~14.6%	(Kim et al., 2025; Patel et al., 2011)
Biochemical recurrence (BCR)	~9.9%	~9.3%	~8.5%	(Kim et al., 2025; Inkaya et al., 2019; Freedland et al., 2005)
Lymph node dissection (PLND)	Median ~19 nodes	Technically possible but less common for extended PLND	Median ~18 nodes	(Ficarra et al., 2012; Dalela et al., 2017; Yaxley et al., 2016)

3.3. Functional Outcomes

3.3.1. Urinary Continence

Urinary continence recovery has an extreme impact on the quality of a patient's life after the treatment. Urinary continence is better and faster provided by the RARP technique than the ORP and LARP methods. According to research provided by Ficarra et al., (2012) 12-month urinary continence rates are 90.2% for RARP, 79.3% for ORP, and 76.1% for LRP ($p < 0.001$). Retzius-sparing RARP approach further improves early continence; there was reported 71% continence recovery at 1 month vs. 48% for standard RARP ($p < 0.001$) in one study (Dalela et al., 2017). The recovery time after ORP is usually longer, and LRP outcomes vary and depend on surgeon experience and cancer size (Stolzenburg et al., 2008).

3.3.2. Erectile Function

Erectile dysfunction is a common issue after RP. Bilateral nerve-sparing RARP has the best early recovery rates. Penson et al., (2005) described 75% recovery at 12 months after RARP, versus 60% after ORP. According to a study by Coughlin et al., (2018) there is higher potency in younger patients who have undergone RARP surgery. Robotic systems used in this technique provide better visualization and precise nerve preservation, especially in the posterolateral regions. Although during LRP and ORP surgeries it is also possible to preserve erectile function, the outcomes of these methods are less predictable, especially if provided by less experienced surgeons. Over time, with proper rehabilitation, there are fewer differences between all approaches (Penson et al., 2005).

3.3.3. Complications and Safety

There are lower complication and reoperation risks after RARP operations than after the other two methods. Wu et al., (2021) reported in their study that 90-day complication rates are 8.2% for RARP, 10.9% for LRP, and 14.6% for ORP ($p < 0.01$). There are also fewer

anastomotic leaks, wound infections, and thromboembolic events in patients who have undergone RARP, according to Inkaya et al., (2019). Major complications (Clavien–Dindo grade ≥III) were lowest with RARP (2.1%) and highest with ORP (5.3%) (Kim et al., 2025). Readmission and reoperation rates were also lowest after RARP surgery.

3.3.4. Cost and Resource Utilization

The RARP technique is the most expensive method among all these surgical approaches, but it may cause lower overall expenses due to the reduced risk of complications and a shorter hospital stay. Wu et al., (2021) study found that total healthcare costs were lower for RARP despite 20-30% higher procedural expenses ($p < 0.001$). Shorter hospital stay and earlier return to work also contribute to its financial value. The high cost of robotic technology may limit access in low-resource settings; however, increasing availability can help bridge this gap.

Functional outcomes are summarized in Table 3. RARP technique provides the best functional outcomes in continence, erectile function, and safety. It has lower complication and reoperation rates, and its cost may be reduced due to shortened hospitalization time. The LRP method provides intermediate outcomes but is limited by its difficulty. ORP surgery remains an effective technique; however, it has higher morbidity and slower functional recovery.

Table 3. Functional Outcomes of ORP, LRP, and RARP

Parameter	ORP	LRP	RARP	References
Urinary continence (1 year)	~79.3%	~76.1%	~90.2%	(Ficarra et al., 2012; Dalela et al., 2017; Stolzenburg et al., 2008)
Erectile function (1 year)	~60% recovery	Variable	~75% recovery	(Coughlin et al., 2018; Penson et al., 2005)
Complications (90-day)	14.6% overall; major ~ 5.3%	10.9% overall; major ~ 3-4%	8.2% overall; major ~ 2.1%	(Kim et al., 2025; Inkaya et al., 2019; Wu et al., 2021)
Cost and resource use	Lowest procedure cost	Intermediate	Highest procedure cost	(Wu et al., 2021)

Radical prostatectomy is still the most commonly used approach to treat localized prostate cancer. The transition from open (ORP) to laparoscopic (LRP) and robot-assisted (RARP) surgery is a move to enhance surgical precision, lessen morbidity, and improve functional outcomes at the expense of oncological control. In this discussion, different outcomes of ORP, LRP, and RARP techniques were compared.

4. OUTCOMES

4.1. Perioperative Outcomes

Minimally invasive methods and especially RARP, demonstrate superior perioperative profiles. Moreover, RARP is associated with lower estimated blood loss, fewer transfusion needs, and shorter hospital stays than other methods (Kim et al., 2025; Inkaya et al., 2019). RARP surgery initially has a longer operative time. However, it decreases with the growing experience of the operator and has the possibility to reduce to be equal to the ORP operation time (Kim et al., 2025; Coughlin et al., 2018). Catheterization and hospitalization durations are also shorter when using RARP, and this leads to quicker recovery and improved resource efficiency (Wu et al., 2021). Summarizing, the LRP technique is better than ORP in some parameters, but the RARP approach offers more benefits in perioperative results than other methods.

4.2. Oncological Outcomes

All three techniques generally offer the same cancer control when performed by experienced surgeons and show similar results in biochemical recurrence (BCR) and lymph node dissection risks (Lowrance et al., 2010; Trinh et al., 2012; Patel et al., 2011). However,

RARP has an advantage in lowering positive surgical margins (PSMs), especially in pT2 cases (Kim et al., 2025; Sooriakumaran et al., 2012). Its precise apical and posterolateral dissection possibilities likely contribute to this difference.

Lymphadenectomy when using RARP matches ORP in yield and nodal positivity. LRP is a less frequently used technique for extended lymph node dissection due to higher complexity and complication risk (Patel et al., 2011). Summarizing, oncologic efficacy of all methods is comparable, but RARP may provide some improvements in margin control and staging accuracy.

4.3. Functional Recovery

RARP is the best operative technique when comparing all methods in the early recovery of continence and erectile function (Freedland et al., 2005). LRP outcomes are variable and depend heavily on surgical expertise. ORP disadvantages among these approaches are tissue disruption and worse inferior visualization (Tewari et al., 2003).

4.4. Complication Rates

RARP shows a lower rate of intraoperative and postoperative complications, including rectal injury, wound infection, and thromboembolism, in comparison to other techniques (Inkaya et al., 2019; Wu et al., 2021; Dalela et al., 2017). LRP shares some advantages of minimally invasive surgery. However, its technical demands limit consistency across different centers. ORP is still associated with a higher morbidity rate due to more extensive dissection and longer recovery after surgery (Yaxley et al., 2016). However, complication rates across all techniques strongly vary with surgeon and institutional experience.

5. CONCLUSION

In this comparative review, the most commonly used radical prostatectomy techniques in managing localized prostate cancer were evaluated. All the ORP, LRP, and RARP methods provide effective oncologic control in appropriately selected patients. However, minimally invasive approaches, especially the RARP technique, offer clear perioperative and functional advantages. The RARP method is associated with numerous benefits, such as reduced blood loss, shorter hospital stays, fewer complications, more rapid catheter removals, and enhanced recovery of urinary and sexual functions, due to better visualization and surgical skill. ORP surgery remains a current treatment option in some low-resource institutions.

Long-term cancer control appears generally the same across all techniques when performed by skilled surgeons. Consequently, surgical choice should be related to institutional resources, surgeon experience, and patient-specific factors. With expanding access to robotic systems and growing emphasis on robotic training among urology specialists, RARP is likely to become the most popular approach. Future research should focus on refining indications and integrating emerging technologies to improve outcomes further and enhance the quality of patients' lives.

Acknowledgments

The authors have no acknowledgments to disclose.

Author contributions

Conceptualization: Mykola Sobchynskyi, Andrzej Myrny
Methodology: Wiktoria Kasianik, Darya Lazitskaya
Formal analysis: Natalia Surosz, Kamil Turlej
Investigation: Iga Kiełbaszewska, Dmytro Kowalczuk, Katsiaryna Miraniuk
Writing-rough preparation: Valeryia Milasheuskaya, Dmytro Kowalczuk, Dawid Wiczkowski
Writing-review and editing: Mykola Sobchynskyi, Andrzej Myrny
Supervision: Mykola Sobchynskyi, Andrzej Myrny
All authors have read and agreed with the published version of the manuscript.

Informed consent

Not applicable.

Ethical approval
Not applicable.

Funding
This study has not received any external funding.

Conflict of interest
The authors declare that there is no conflict of interest.

Data and materials availability
All data sets collected during this study are available upon reasonable request from the corresponding author.

REFERENCES

1. Coughlin GD, Yaxley JW, Chambers SK, Occhipinti S, Samaratunga H, Zajdlewicz L, Teloken P, Dunglison N, Williams S, Lavin MF, Gardiner RA. Robot-assisted laparoscopic prostatectomy versus open radical retropubic prostatectomy: 24-month outcomes from a randomized controlled study. Lancet Oncol 2018;19(8):1051–1060. doi: 10.1016/S1470-2045(18)30357-7
2. Dalela D, Jeong W, Prasad MA, Sood A, Abdollah F, Diaz M, Karabon P, Sammon J, Jamil M, Baize B, Simone A, Menon M. A Pragmatic Randomized Controlled Trial Examining the Impact of the Retzius-sparing Approach on Early Urinary Continence Recovery After Robot-assisted Radical Prostatectomy. Eur Urol 2017;72(5):677-685. doi: 10.1016/j.eururo.2017.04.029.
3. Ficarra V, Novara G, Rosen RC, Artibani W, Carroll PR, Costello A, Menon M, Montorsi F, Patel V, Stolzenburg JU, Van Poppel H, Zattoni F. Systematic review and meta-analysis of studies reporting urinary continence recovery after robot-assisted radical prostatectomy. Eur Urol 2012;62(3):405–417. doi: 10.1016/j.eururo.2012.05.045
4. Freedland SJ, Humphreys EB, Mangold LA, Eisenberger M, Dorey FJ, Walsh PC, Partin AW. Risk of prostate cancer–specific mortality following biochemical recurrence after radical prostatectomy. JAMA 2005;294(4):433–439. doi: 10.1001/jama.294.4.433
5. Inkaya A, Tahra A, Sobay R, Kumcu A, Küçük EV, Boylu U. Comparison of surgical, oncological, and functional outcomes of robot-assisted and laparoscopic radical prostatectomy in patients with prostate cancer. Turk J Urol 2019;45(6):410–417. doi: 10.5152/tud.2019.48457
6. Kim DK, Moon YJ, Chung DY, Jung HD, Jeon SH, Kang SH, Paick S, Lee JY; Korean Society of Endourology and Robotics (KSER) Research Committee. Comparison of Robot-Assisted, Laparoscopic, and Open Radical Prostatectomy Outcomes: A Systematic Review and Network Meta-Analysis from KSER Update Series. Medicina (Kaunas). 2025;61(1):61. doi: 10.3390/medicina61010061.
7. Lowrance WT, Elkin EB, Jacks LM, Yee DS, Curtis GL, Disaia PJ, Eastham JA. Comparative effectiveness of prostate cancer surgical treatments: A population-based analysis of postoperative outcomes. J Clin Oncol 2010;28(24):4216–4222. doi: 10.1016/j.juro.2009.12.021
8. Patel VR, Sivaraman A, Coelho RF, Chauhan S, Palmer KJ, Orvieto MA, Camacho I, Coughlin G, Rocco B. Pentafecta: A new concept for reporting outcomes of robot-assisted laparoscopic radical prostatectomy. Eur Urol 2011;59(5):702–707. doi: 10.1016/j.eururo.2011.01.032
9. Penson DF, McLerran D, Feng Z, Li L, Albertsen PC, Gilliland FD, Hamilton A, Hoffman RM, Stephenson RA, Potosky AL, Stanford JL. 5-year urinary and sexual outcomes after radical prostatectomy: results from the prostate cancer outcomes study. J Urol 2005;173(5):1701-5. doi: 10.1097/01.ju.0000154637.38262.3a.
10. Sooriakumaran P, Haendler L, Nyberg T, Gronberg H, Nilsson A, Carlsson S, Hosseini A, Adding C, Jonsson M, Ploumidis A, Egevad L, Steineck G, Wiklund P. Biochemical recurrence after robot-assisted radical prostatectomy: a multicentre study. Eur Urol 2012;62(3):427–432. doi: 10.1016/j.eururo.2012.05.024
11. Stolzenburg JU, Rabenalt R, Do M, Schwalenberg T, Winkler M, Dietel A, Liatsikos E. Intrafascial nerve-sparing endoscopic extraperitoneal radical prostatectomy. Eur Urol 2008;53(5):931-40. doi: 10.1016/j.eururo.2007.11.047.
12. Tewari A, Srivasatava A, Menon M. A prospective comparison of radical retropubic and robot-assisted prostatectomy: Experience in one institution. BJU Int 2003;92(3):205–210. doi: 10.1046/j.1464-410x.2003.04311.x
13. Trinh QD, Sammon J, Sun M, Ravi P, Ghani KR, Bianchi M, Jeong W, Shariat SF, Hansen J, Schmitges J, Jeldres C, Rogers CG, Peabody JO, Montorsi F, Menon M, Karakiewicz PI.

Perioperative outcomes of robot-assisted radical prostatectomy compared with open radical prostatectomy: results from the nationwide inpatient sample. Eur Urol 2012;61(4):679-85. doi: 10.1016/j.eururo.2011.12.027.

14. Wu S-Y, Chang S-C, Chen C-I, Huang C-C. Latest comprehensive medical resource consumption in robot-assisted versus laparoscopic and traditional open radical prostatectomy: A nationwide population-based cohort study. Cancers (Basel) 2021;13(7):1564. doi: 10.3390/cancers13071564
15. Yaxley JW, Coughlin GD, Chambers SK, Occhipinti S, Samaratunga H, Zajdlewicz L, Dunglison N, Carter R, Williams S, Payton DJ, Perry-Keene J, Lavin MF, Gardiner RA. Robot-assisted laparoscopic prostatectomy versus open radical retropubic prostatectomy: Early outcomes from a randomized controlled phase 3 study. Lancet 2016;388(10049):1057–1066. doi: 10.1016/S0140-6736(16)30592-X